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The U.S. Approach: Deminer Personal Protective Equipment Development

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The deminer and his partner began work at 0730. By 0850, they had cleared 50 square meters. Both men wore frag-jackets, helmets and visors. The victim was clearing by using his prodder. He was called to help his section leader remove grass from a large pothole in the road. As he returned at 0850, he stepped on a mine he had previously missed. (Extracted from the Database of Demining Incident Victims, 1999, Incident #53.)

At around 1110, the deminer got a detector reading and began prodding and excavating the ground using a bayonet held in his left hand. A PPM-2 mine detonated. The victim was knocked backward about two meters by the blast and was lying partly in an uncleared area. He stood up quickly, leaving his visor that had been blown away and broken by the blast. The victim received first aid and arrived at the field hospital at 1120. The victim's visor was described as riddled by fragments and broken at the weak points of the articulation on both sides of the head frame. His frag jacket stopped all projections, limiting injuries to the most exposed parts. (Extracted from the Database of Demining Victims, 1999, Incident #63.)

The Supervisor was a highly experienced UXO specialist. He was placing charges on damaged PMD-6 mines found by deminers to destroy them. He placed one charge by a PMD-6 and stood up to move to a second mine only two meters away. As he stood, he tripped and fell, landing on the second mine. He either landed on his hand or his knee on the left side, knocking the pin from the MUV switch/fuze in the mine as he did so. In the detonation, he suffered traumatic amputation of his left knee and left arm. He also had blast injuries on the left side of his face and chest. The chest injuries were light because the victim was wearing a fiberglass back support as a result of an earlier, non-demining related injury. He was not wearing any protective equipment. His eyes were undamaged. The victim remained conscious. He was the radio operator on site, so he had to explain to others how to call for the helicopter medevac. (Extracted from the Database of Demining Victims, 1999, Incident #19.)

Introduction

In 1998, the United States placed increasing emphasis on developing Personal Protective Equipment (PPE) for the individual operator engaged in humanitarian demining. It was believed that development of improved PPE suitable for humanitarian demining was well within the bounds of currently available technology. During the previous year, several conferences had highlighted the need for better protection of deminers. In March 1998, the U.S. Department of Defense—through the Night Vision and Electronic Sensors Directorate—hosted a Mine Action Center Workshop to specifically focus on individual deminer needs. Foremost among the requirements of workshop participants was the need to develop PPE that was specifically designed and developed with the deminer in mind. The characteristics of deminer "body armor" that were discussed at this workshop included: affordability, lightweight and modularity allowing flexibility to tailor the PPE to the specific needs of individual deminers and environments.

Research

To better focus the development of deminer PPE, NVESD was requested to conduct a market survey of existing body armor as well as undertake research to better understand the nature of deminer injuries. Additionally, the U.S. Army's Surgical Research Institute in Fort Sam Houston, Texas, was contracted to conduct extensive research into landmine injuries of the lower extremities. Its research efforts in the Lower Extremity Assessment Program are discussed further in this journal.

Additionally, NVESD partnered with the Army's Natick Laboratories and Aberdeen Test Center as well as the Canadian Centre for Mine Action Technologies to conduct extensive blast effects testing on existing PPE. NVESD also embarked on a program to develop demining PPE that could be made commercially available within a short period of time. To this end, NVESD contracted with Med-Eng Systems of Canada to develop the Humanitarian Demining Ensemble, which is currently available and has already been purchased for use in South America and the Middle East.

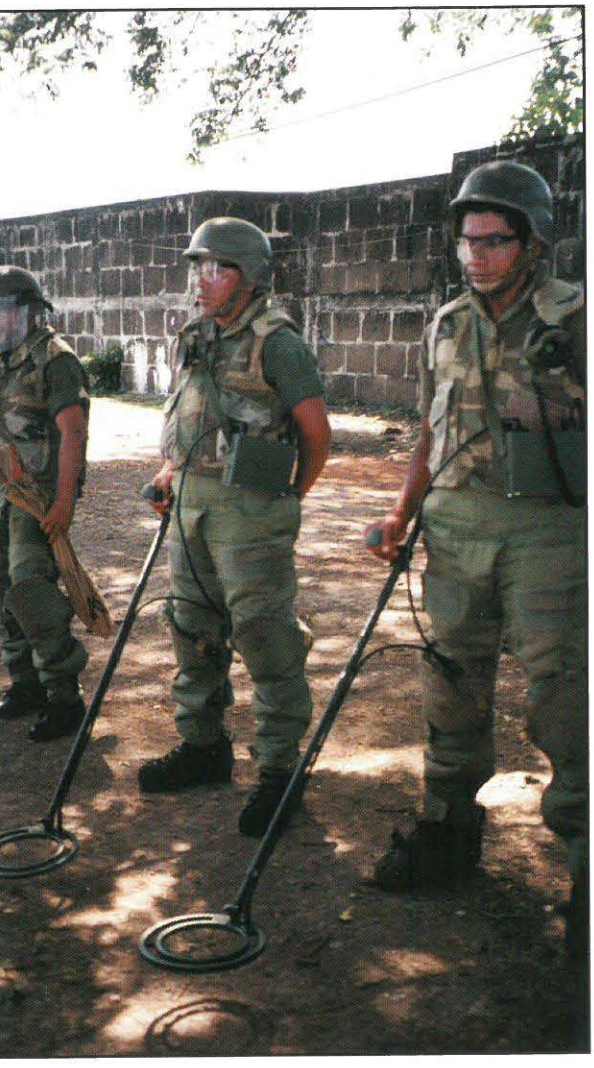
Furthermore, NVESD worked with Andy Smith to develop PPE that could be locally produced in a mine-affected country. The U.S. demining technology development program endorses both approaches, i.e., development of commercially available PPE for demining organizations and donors who can afford to buy it as well as locally manufactured body armor for countries wishing to establish an indigenous capability. The caveat in this endorsement, of course, is that both meet minimally acceptable standards of protection. Finally, the further services of Andy Smith were retained to gather field data pertaining to deminer injuries. Due primarily to his significant interest in PPE as well as his access to and knowledge of several demining theaters, it was felt that Smith had an extremely useful insight and perspective on deminer injuries.

Landmine Casualty Data Report: Deminer Injuries

Smith's research was carried on from September 1998 to June 1999. Deminer injury information was gathered from Afghanistan, Angola, Bosnia-Herzegovina, Cambodia, Cuba (Guantanamo Bay), Iraq, Laos, Mozambique and Zimbabwe. In many cases, it was possible to gather information directly through interviews with the individuals involved. In other instances, pertinent information was extracted from investigative, medical and insurance reports. Eventually, information was collected covering the period from 1993 through 1998, on 236 incidents, involving 301 victims.

An independent analysis of Smith's database by

Personal Protective Equipment must take into account the deminers' safety and comfort.
Photo c/o AP/World Wide Photos



Injuries to the legs and head are the most common injuries suffered by deminers.
Photo c/o Will Boyce

the U.S. military's Casualty Care Research Center in Bethesda, Maryland, produced a study entitled "Landmine Casualty Data Report: Deminer Injuries," which is possibly the first of its kind. This analysis revealed some particularly useful information pertaining to deminer injuries and their causes. It was found, for example, that the most common landmines causing injuries and, in some instances, death, were AP blast mines. The most commonly encountered mines in this category were the PMN, PMN-2 and the Type 72. The activity that deminers were most often engaged in when an incident occurred was prodding, which accounted for 29 percent of the incidents. Although some demining practitioners claim that missing mines should not occur, it does, accounting for 26 percent of the incidents.

Upon further review of the data, it was determined that the legs were the most common location of deminer injuries with 63 percent suffering injuries to their lower extremities. Injuries to the head were the next most common occurrence (56 percent), the arms (55 percent), the torso (33 percent) and the eyes (30 percent). In those suffering eye injuries, 10.5 percent sustained permanent blindness. Thirty-seven of the deminers involved in incidents became fatalities (12.5 percent). The majority of these were killed while clearing vegetation.

The study draws several conclusions that can be implemented today to help reduce deminer injuries. Among these are that deminers should wear facial and eye protection. Additionally, deminer injuries and deaths could be reduced through improvements in PPE, procedures and medical response. Finally, the study draws the potentially contentious conclusion that the accumulated data presented in the research "was insufficient to show any effect of the wearing of an armor vest, jacket or apron for either minor or severe injuries and therefore does not prove or disprove the effectiveness of this type of protective equipment."

The study goes on to recommend that a standardized format be developed and adopted for reporting mine incidents and injuries. The data in the study also supports the "need to develop and establish test and evaluation protocols for measuring the effectiveness of protective equipment (i.e., minimum standards) against mines that are likely to be found in demining operation environments." Additionally, the study recommends that additional data be obtained validating the effectiveness of protective vests, jackets or aprons. Finally, analysis of the data suggests that research and development into more effective footwear has the potential to mitigate the most common form of lower extremity injury—amputations, which occurred in 42 percent of the cases of leg injuries.

Conclusion

Although the United States anticipates concluding the majority of its research and development into deminer protective clothing during fiscal 2000, modifications and testing of existing PPE will continue throughout the duration of the program. Additionally, development and testing of visors, helmets and deminer hand tools will also continue. The rationale for this is that PPE should be considered as an integral part of a deminer's "tool box," not just simply as a nice-to-have accessory.

As such, future development as well as testing of PPE should use a systems-oriented approach. For example, visors should not be tested separately but should be evaluated in conjunction with the helmet they will be attached to or the protective vest that they will interface with. It is only in this manner that their full strengths and weaknesses will be identified.

Copies of Andy Smith's Database of Demining Incident Victims can be obtained by contacting him directly. The "Landmine Casualty Data Report: Deminer Injuries, February 2000," can be viewed on the Night Vision Electronic sensors Directorate website at www.demining.brtrc.com. ■

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